Decay Pipe Review
W.B.S. 1.1.4

- Design and Engineering (Dave Pushka) - 40 min.
  - Vacuum Shell
  - Pump-Down Calculation
  - Decay Pipe Cooling
  - Installation Oversight
  - Known Outstanding Issues
- Design and Engineering of the Vessel Ends (Ed Chi) -30 min.
  - Upstream End
  - Downstream End
  - Access Port
- Costs (Bob Bernstein) – 15 min.
- Questions, Discussions, Comments, Warnings, etc. (all)

Vacuum Shell

- Externally stiffened shell, t = 3/8”, stiffeners @ 180”
- A-36 carbon steel shell with A-36 stiffeners.
- Exterior painted with zinc rich organic primer.
- Stiffening contribution from the concrete shielding is not included.
- Calculations:
  - prepared by SA Healy’s Subcontractor and decay pipe installer, CBI.
  - checked by Ed Chi (PPD), Russ Alber (FESS) and Dave Pushka (BD).
- Calculations presently do not include the required stiffeners to resist the hydraulic pressure of the concrete shielding placement nor the buoyant forces due to concrete placement. SAH has been notified that the calculations are not complete. Requirements depend heavily on the concrete placement rate.

Pump Down Calculation

- Pump down time is estimated at 24 hours.
- Based on using one 400 cfm mechanical vacuum pump similar to the pumps at KTeV.
- Pump will be located approximately 100 feet away from the downstream end of the decay pipe, in the absorber access tunnel.
- Radiation levels at the vacuum pumps should be almost low enough for limited occupancy. Therefore, no problems with the equipment are expected. Vacuum pump oil will need to be surveyed before it is recycled.
- Goal vacuum is 1 torr.
- Pump down occurs entirely within the viscous flow regime. Conductance of the decay pipe is huge. Therefore, pumping from one end is sufficient.
- Two pumps will be installed, one as a hot stand-by. See schematic drawing 8875.117-ME-406092

Decay Pipe Cooling

- Mars simulations indicate that approximately 130 kW will be deposited in the decay pipe steel and shielding from the beam.
- Decision to allow the TBM resulted in a decay pipe shielding scheme where the concrete is placed tightly against the rock. Therefore, the only 'natural' means of removing heat would be by conduction into the rock. Rock is a poor thermal conductor.
- 12 one inch nominal diameter (1.125 o.d) soft drawn copper tubes will be attached to the outside of the decay pipe before the concrete is placed. Water enters at 60 °F, leaves at 70 °F
- Thermal analysis by Ang Lee indicated that the maximum temperature is 40 C above that of the cooling water.
- Stress analysis by Bob Wands, MSG-EAR-00280, indicates that the thermally induced stresses are below the ASME allowable stresses for the steel at these temperatures.

Installation Oversight

- Our specification to SA Healy requires solution film leak testing of the welded joints in the pipe.
- We have budgeted 13 man-weeks (which is consistent with CBI's anticipated decay pipe installation duration) for a technician to verify that the solution film testing is being performed and is being performed competently.
- This effort is above and beyond the normal construction oversight normally provided by the construction coordinator.
- A yet to be identified technician will need to learn this leak checking technique and ideally should be qualified as a level 1 NDE specialist in this examination method.

Engineering Documentation

- FESHM 5033 requires the preparation of an engineering note for vacuum vessels.

- Ed Chi (PPD/MSD) has been asked to prepare this engineering note.
- This engineering note will include:
  - Vacuum Shell calculations prepared by CBI
  - Calculations for the upstream end of the decay pipe designed by Ed Chi.
  - Calculations for the downstream end of the decay pipe designed by Ed Chi.
  - Calculations for the access port for the decay pipe designed by Ed Chi.

- Ed will address the status of this engineering note.

Known Outstanding Issues

- Possible galvanic corrosion between the steel decay pipe and the copper cooling tubes.
- Considering using PVC plastic pipe to provide an electrical isolation between these dissimilar metals.
- Will have to be installed by CBI before SAH installs the concrete.
- Have yet to approach SAH on the possible cost impact. Material may be less than $10k, and actual labor may not be so great, but SAH may also add the substantial additional costs due to the possible extension of their critical path.

- Any better ideas?

Handouts

- Specification for the Decay Pipe Included in the Tunnels & Halls RFP.
- Calculations on the Vacuum Shell Provided by CBI.
- Calculation on the vacuum decay pipe pump down time by DRP.
- ANSYS Output on the temperature of the decay pipe and its shielding as a function of position by Ang Lee.
- Finite Element Thermal and Stress Analysis of NuMI Decay Pipe by Bob Wands (MSG-EAR-00280).
- Piping and Instrumentation Diagram for the Decay Pipe Vacuum. 8875-117-MD-406092
- Piping and Instrumentation Diagram for the Decay Pipe Cooling 8875-117-ME-363632
- Piping and Instrumentation Diagram Legend Sheet 8875-117-MC-363721